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AUTHOR Moss, Jeffrey
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ABSTRACT

This handbook is a product of a research project conducted in North Carolina to identify science competencies taught in vocational agriculture programs. Specifically, two vocational agriculture courses were included in the study: Introduction to Agriculture/National Resources and Ornamental Horticulture I. Of the 60 competencies in the Introduction to Agriculture/National Resources, 24 were identified as being similar to competencies taught in high school science courses. Six of the 41 competencies in Ornamental Horticulture I were found to be directly related to competencies taught in biology and physical science. A listing of the agriculture competencies and their relationship to science competency goals (i.e., those for biology, earth science, and physical science) is found in Section I of this handbook. Section II of the handbook contains teaching materials that can be used to supplement instruction of the science-related competencies identified in the study. Most of the materials can be used as transparency masters or handouts. The final section of the handbook contains a list of selected resources that may be used by vocational agriculture teachers to supplement their instruction of the identified science-related agricultural competencies. The competencies identified in Section I of the handbook are listed followed by the name and description of at least one resource. Information necessary for ordering the resources is included. (KC)

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Teaching Science in Vocational Agriculture

An Identification of Science Competencies Taught in
- Ornamental Horticulture
- Introduction to Agriculture/ Natural Resources

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Jeffrey W. Moss
Department of Occupational Education

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This handbook is a product of a research project entitled, "An Identification of Science Competencies Taught in Vocational Agriculture Programs" which was funded by the Division of Vocational Education, North Carolina Department of Public Instruction. Specifically, two vocational agriculture courses were included in the study. Introduction to Agriculture/Natural Resources and Ornamental Horticulture I.

Twenty-four (24) of the 60 competencies in the Introduction to Agriculture/Natural Resources course were identified as being similar to competencies taught in high school science courses such as Biology, Earth Science, and Physical Science. The comparison was made only between the vocational agriculture competencies in the Introduction course and those competencies taught in high school science. Additional competencies could have been identified had comparisons also been made between vocational agriculture and middle school or elementary science courses.

Six (6) of the 41 competencies in Ornamental Horticulture I were found to be directly related to competenices taught in Biology and Physical Science. Again, the comparison was only made between Ornamental Horticulture I and high school science courses. You may have been unaware that many of the competencies taught in vocational agriculture were so similar to competencies taught in science. A listing of the agriculture competencies and their relationship to science competency goals as identified in the Competency Goals and Performance Indicators K-12 Instructional Services, North Carolina Department of Public Instruction, can be found in Section I of this handbook.

Teaching materials that can be used to supplement instruction of the science related competencies identified in the study can be found in Section II of the handbook. Transparency masters are used with the permission of the source and you as a teacher most likely have not seen them previously since they were developed in other states. It is hoped that these transparencies will be of great help to you when teaching the identified competencies.

Additional resources that can be used to supplement your instruction of science related agriculture competencies can be found in Section III of the handobook. Information for purchasing the resource is made available.

One final word. Please share the information in this handbook with the science teachers in your school. You teach many similar competencies and may be able to share resources and learn from one another concerning the best way to teach related science and vocational agriculture competencies.

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One final word. Please share the information in this handbook with the science teachers in your school. You teach many similar competencies and may be able to share resources and learn from one another concerning the best way to teach related science and vocational agriculture competencies.

INTRODUCTION TO SECTION I OF THIS HANDBOOK

The primary purpose of this funded research study was to identify science competencies that are presently being taught in vocational agriculture, specifically the Introduction to Agriculture/ Natural Resources course and Ornamental Horticulture I.

As a vocational agriculture teacher, you will discover that you teach many of the same competencies/principles in your vocational agriculture classes as do the biology, earth science, and physical science teachers in your school. You may wish to discuss the information found in this section with the science teachers in your school to learn how and specifically what they teach about these overlapping competencies. You may be able to share ideas that will lead to improved instruction in both vocational agriculture and science classes.

The relationship between the agricultural competencies in Introduction to Agriculture/Natural Resources and Ornamental Horticulture I and specific science competency goals for Biology, Earth Science, and Physical Science are identified in this section.

INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES

(COURSE NUMBER 7000-7010)

Twenty-four (24) of the 60 competencies were identified as containing a substantial amount of science related instruction. A listing of each agriculture competency and the corresponding science competency goal(s) is found in this section of the handbook.

SUMMARY OF SCIENCE RELATED AGRICULTURAL COMPETENCIES IN THE

"INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES" COURSE

(Course Number 7000-7010)

Biology	Earth Science	Physical Science	INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES - COMPETENCIES
*	*	*	013. Identify and describe proper use of tools and equipment.
		*	019. Identify and describe processes involved in the generation and distribution of electricity.
		*	020. Define and describe the use of electrical terms.
		*	021. Identify different kinds of electrical circuits and control devices.
		*	022. Compute problems involving the amount and cost of electric energy.
*			027. Identify and describe the distinguishing breed characteristics of beef and dairy cattle, swine, sheep and poultry.
*			028. Identify and describe the functions of nutrients essential for animal growth and development.
*			031. Identify the most common pests and diseases of animals and methods of control.
	*		034. Identify the factors affecting soil formation.
	*		035. Describe the various properties of soils.
*			039. Identify and classify plants according to use and economic value.
*			040. Identify primary and secondary nutrient requirements of plants.
*			041. Identify and describe the functions of the parts of plants.
*			042. Identify and describe methods of plant reproduction.
*			043. Describe the advantages of using hybrid and certified seeds and plants.
*			044. Identify at least five diseases and methods of control of plants common to the local area.
*			045. Identify at least five insects that affect plants in the local area and methods of control.
*			047. Demonstrate ability to propagate plants using three specified methods.
	*		049. Describe at least three reasons for man to conserve natural resources.
*			050. Identify the major fish species in specified waterways.
	*		051. Identify the sources and physical qualities of water.
	*		052. Identify rocks and minerals found in the local area.
	*		054. Identify the main categories and sources of pollution.
	*		055. Identify at least three ways modern agricultural practices have improved the environment.

RELATIONSHIP BETWEEN "INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES" COMPETENCIES AND SCIENCE COMPETENCIES*

BIOLOGY

Agricultural Competency	Science Competency Goals*
027. Identify and describe the distinguishing breed characteristics of beef and dairy cattle, swine, sheep and poultry.	The learner will: Understand the general characteristics of vertebrates. Understand similarities and differences in the anatomy of vertebrates.
028. Identify and describe the functions of nutrients essential for animal growth and development.	Understand that life is a chemical process.
031. Identify the most common pests and diseases of animals and methods of control.	Have a general understanding of viruses and bacteria. Understand the nature of fungi.
039. Identify and classify plants according to use and economic value.	Demonstrate the ability to classify.
040. Identify primary and secondary nutrient requirements of plants.	Understand how plants grow and reproduce. Understand the physiology of plants.
041. Identify and describe the functions of the parts of plants.	Understand the nature of seed plants. Understand the physiology of plants. Understand how plants grow and reproduce.
042. Identify and describe methods of plant reproduction.	Understand the nature of seed plants. Understand how plants grow and reproduce.
043. Describe the advantages of using hybrid and certified seeds and plants.	Understand that living things receive characteristics from parent organism(s). Understand that organic variation is significant.

*As identified in the Competency Goals and Performance Indicators K-12 Instructional Services/N. C. Dept. of Public Instruction

044. Identify at least five diseases and methods of control of plants common to the local areas. → Have a general understanding of viruses and bacteria.
→ Understand the nature of fungi.

045. Identify at least five insects that affect plants in the local area and method of control. → Understand the role and nature of arthropods.

047. Demonstrate ability to propagate plants using three specified methods. → Understand how plants grow and reproduce.

050. Identify the major fish species in specified waterways. → Understand the nature of fish.

RELATIONSHIP BETWEEN "INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES" COMPETENCIES AND SCIENCE COMPETENCIES*

EARTH SCIENCE

Agricultural Competency	Science Competency Goals*
034. Identify the factors affecting soil formation.	The learner will: Know that minerals and rocks respond to exposure to the earth's surface environment and are changed by a process called weathering. Know that if weathered rock remains in place long enough, a mature soil will develop.
035. Describe the various properties of soil.	Know that if weathered rock remains in place long enough, a mature soil will develop.
049. Describe at least three reasons for man to conserve natural resources.	Know that the earth is a closed system in space with limited resources. Know that the earth's environment is fragile and easily damaged. Know that the earth as a home for people depends on their actions
051. Identify the sources and physical qualities of water.	Know that water moves through as well as over the earth as part of the hydologic cycle.
052. Identify rocks and minerals found in the local area.	Understand how the structure, texture and composition of rocks reflect their origin and history.
054. Identify the main categories and sources of pollution.	Know the basic causes and effects of air pollution. Know that the earth as a home for people depends on their actions.
055. Identify at least three ways modern agricultural practices have improved the environment.	Develop a positive attitude toward the need for conservation, preservation and wise use of natural resources.

*As identified in the Competency Goals and Performance Indicators K-12 Instructional Services/N. C. Dept. of Public Instruction.

RELATIONSHIP BETWEEN "INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES" COMPETENCIES AND SCIENCE COMPETENCIES

PHYSICAL SCIENCE

Agricultural Competencies	Science Competency Goals*
019. Identify and describe processes involved in the generation and distribution of electricity.	The learner will: Understand that chemical reactions can produce electricity and vice versa. Understand that electrical energy can be converted into heat and light.
020. Define and describe the use of electrical terms.	Understand that measuring electrical current involves units of pressure, current, and resistance. Understand that Ohm's law is a mathematical statement of the relationship between pressure, resistance, and current.
021. Identify different kinds of electrical circuits and control devices.	Understand that the total circuit voltage of several connected cells depends on whether they are joined in series or parallel. Understand that electrical currents can be controlled and altered with different devices.
022. Compute problems involving the amount and cost of electric energy.	Understand that electric power is the rate at which electrical energy is consumed.

*As identified in the Competency Goals and Performance Indicators K-12 Instructional Services/N. C. Dept. of Public Instruction

RELATIONSHIP BETWEEN "INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES" COMPETENCIES AND SCIENCE COMPETENCIES*

BIOLOGY/MANIPULATIVE SKILLS
EARTH SCIENCE/MANIPULATIVE SKILLS
PHYSICAL SCIENCE/MANIPULATIVE SKILLS

Agricultural Competency	Science Competency Goal*
013. Identify and describe proper use of tools and equipment.	The learner will:
	→ Demonstrate skill in the use of instruments.
	→ Demonstrate skill in how to care for instruments.
	→ Develop skill in constructing simple equipment.

*As identified in the Competency Goals and Performance Indicators K-12 Instructional Services/N. C. Dept. of Public Instruction

ORNAMENTAL HORTICULTURE I

(COURSE NUMBER 7051)

Six (6) of the 41 competencies were identified as containing a substantial amount of science related instruction. A listing of each agricultural competency and the corresponding science competency goal(s) is found in this section of the handbook.

SUMMARY OF SCIENCE RELATED AGRICULTURAL COMPETENCIES

IN THE "ORNAMENTAL HORTICULTURE I" COURSE (COURSE NO. 7051)

Biology	Physical Science	Ornamental Horticulture I Competencies
*		022. Identify the principal parts of horticultural plants.
*		023. Identify and explain the functions of the principal parts of horticultural plants.
*		024. Analyze the processes of growth in horticultural plants.
	*	031. Identify and demonstrate proper uses of fertilizers and chemicals.
*		034. Identify and describe different methods of plant propagation.
*		037. Identify selected bedding plants according to growth habit and use.

RELATIONSHIP BETWEEN "ORNAMENTAL HORTICULTURE I" COMPETENCIES

AND SCIENCE COMPETENCIES*

BIOLOGY

Horticultural Competencies	Science Competency Goal*
022. Identify the parts of horticultural plants.	The learner will: Understand the nature of seed plants.
023. Identify and explain the functions of the principal parts of horticultural plants.	Understand the nature of seed plants.
024. Analyze the processes of growth in horticultural plants.	Understand how plants grow and reproduce. Understand the physiology of plants.
034. Identify and describe different methods of plant propagation.	Understand how plants grow and reproduce.
037. Identify selected bedding plants according to growth and habit and use.	Understand the nature of seed plants. Understand how plants grow and reproduce.

*As identified in Competency Goals and Performance Indicators K-12 Instructional Services/N. C. Department of Public Instruction

RELATIONSHIP BETWEEN "ORNAMANTAL HORTICULTURE I"

COMPETENCIES AND SCIENCE COMPETENCIES*

PHYSICAL SCIENCE

Horticulture Competency	Science Competency Goals*
031. Identify and demonstrate proper uses of fertilizers and chemicals.	The learner will:
	→ Understand that chemical compounds are classified into groups according to certain properties.
	→ Demonstrate the ability to measure.
	→ Demonstrate skill in the use of instruments.

*As identified in Competency Goals and Performance Indicators K-12 Instructional Services/N. C. Department of Public Instruction.

INTRODUCTION TO SECTION II OF THIS HANDBOOK

In this section of the handbook you will find teaching materials that can be used by vocational agriculture or science teachers to facilitate the learning of science related competencies. Existing curriculum materials were reviewed and the best available teaching aids were selected for this section. Thus, the material can be used to improve your teaching methods for science oriented subject matter units.

The material is used with permission from the source and can be duplicated by you for use in your classes. Since the material is from out-of-state sources, it is likely that you have not been using it previously. The information is intended to stress practical ways of helping students learn science in agriculture.

The material is arranged by competency for both the Introduction to Agriculture/Natural Resources and Ornamental Horticulture I.

The source for the transparencies is:

Vocational Instructional Services
FE Box 182
Texas A & M University
College Station, Texas 77843-2588

Write for catalog to obtain additional information.

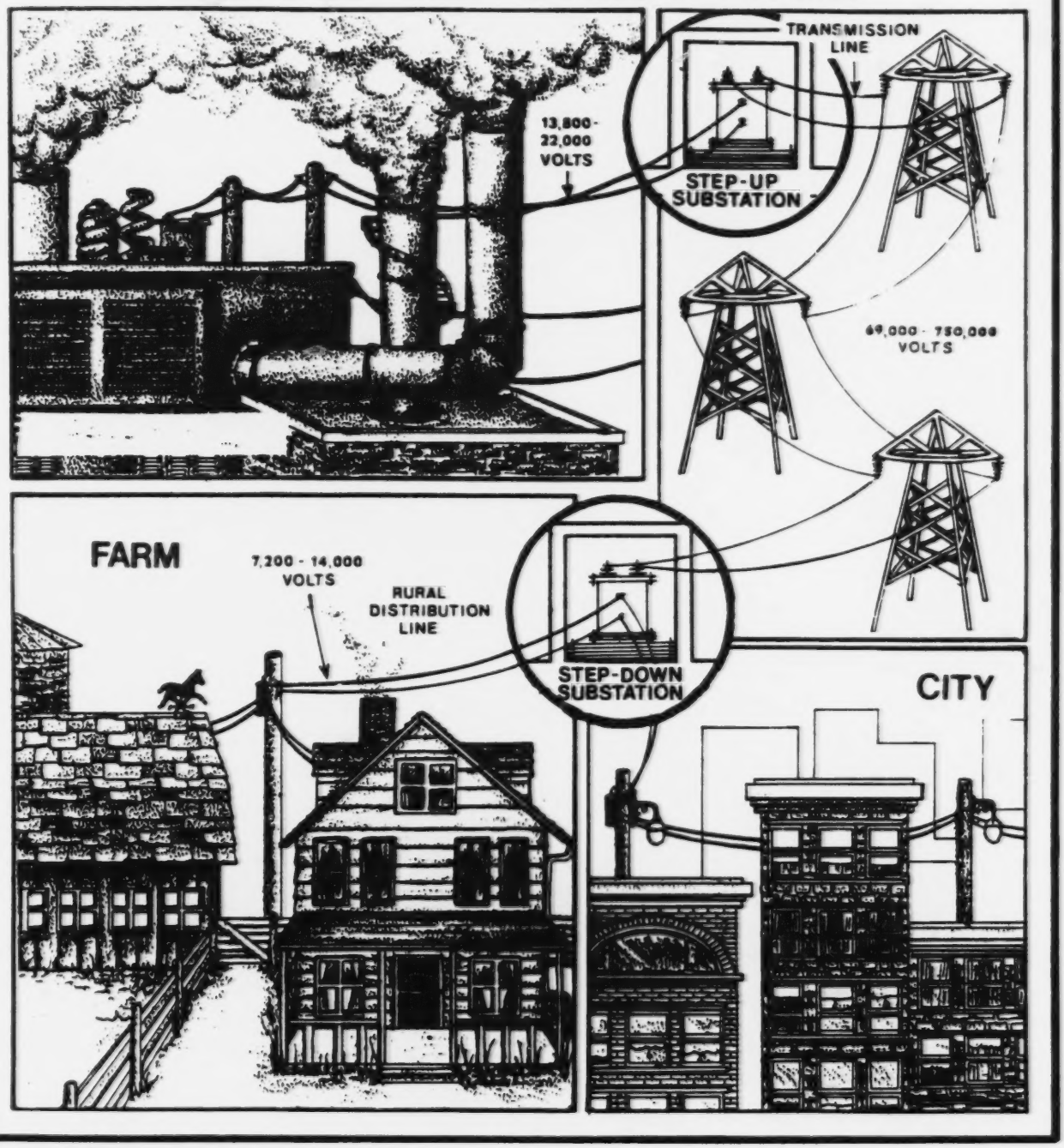
TEACHING MATERIALS FOR

INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES

COMPETENCY

019. Identify and Describe Processes Involved in the Generation and Distribution of Electricity

HOW ELECTRICITY GETS TO THE FARM



COMPETENCY

020. Define and Describe the Use of Electrical Terms

COMMON ELECTRICAL TERMS

electricity - light, heat, power

ampere (amp.) - rate of flow
example: (water - gal./min.)

volt (v) - pressure
example: (lbs./sq. in.)

watts (w) - power
example: (hp)

kilowatts (kw) - 1000 watts

horsepower (hp) - 746 watts = 1 hp

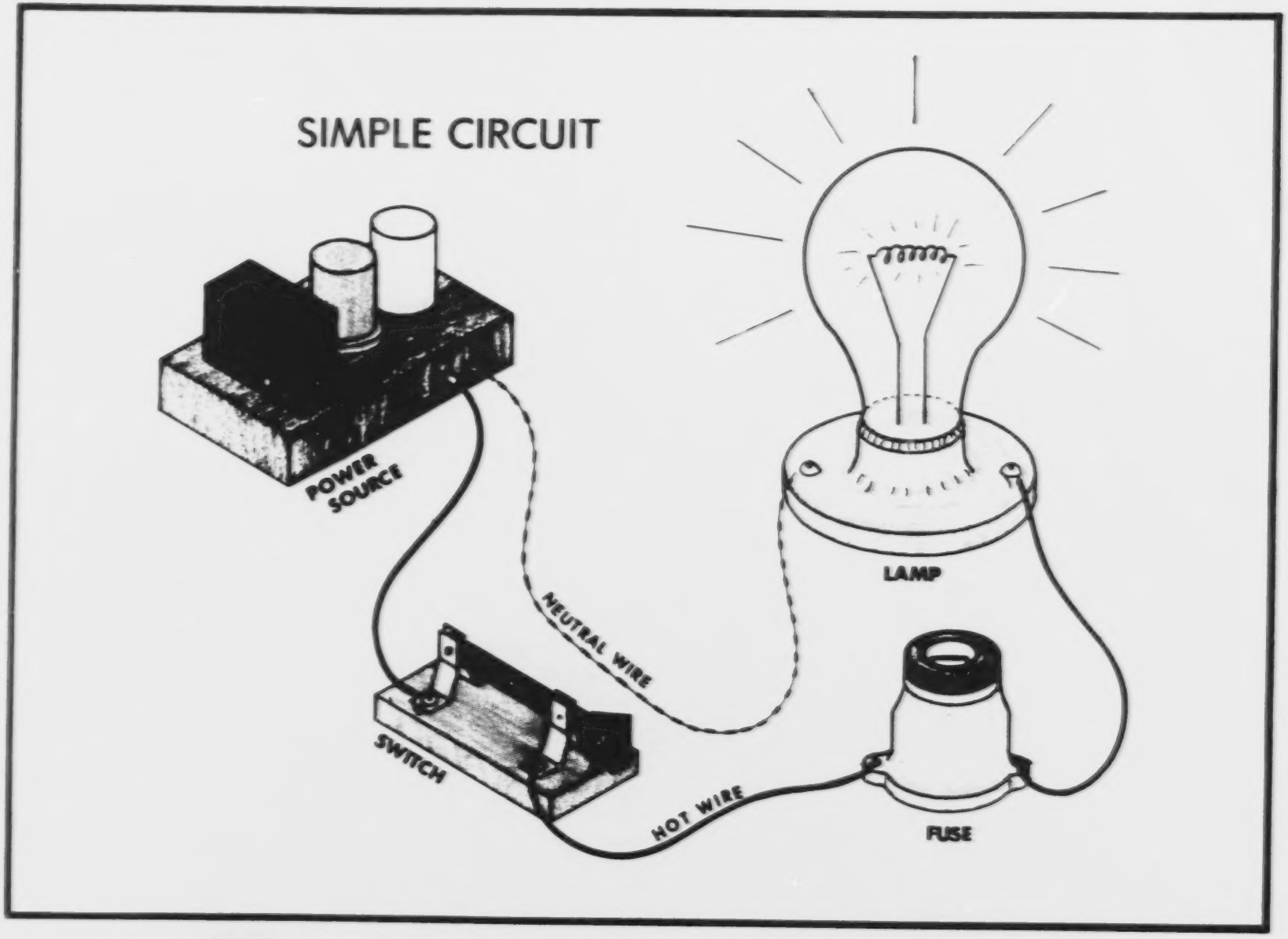
kilowatt-hour (kwh) - 1000 watts used in 1 hour

volts x amps = watts

$$\text{amps} = \frac{\text{watts}}{\text{volts}} \qquad \text{volts} = \frac{\text{watts}}{\text{amps}}$$

COMPETENCY

021. Identify Different Kinds of Electrical Circuits and Control Devices


SIMPLE CIRCUIT
POWER SOURCE
NEUTRAL WIRE
LAMP
SWITCH
HOT WIRE
FUSE

SIMPLE SWITCHES

(CONTROL THE CIRCUIT FROM ONE LOCATION)

SINGLE POLE - SINGLE THROW

TOGGLE

MERCURY

SILENT

ROCKER BUTTON

PUSH BUTTON

THERMOSTAT

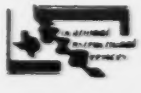
HUMIDISTAT

SIMPLE SWITCHES—

HAVE TWO SCREWS

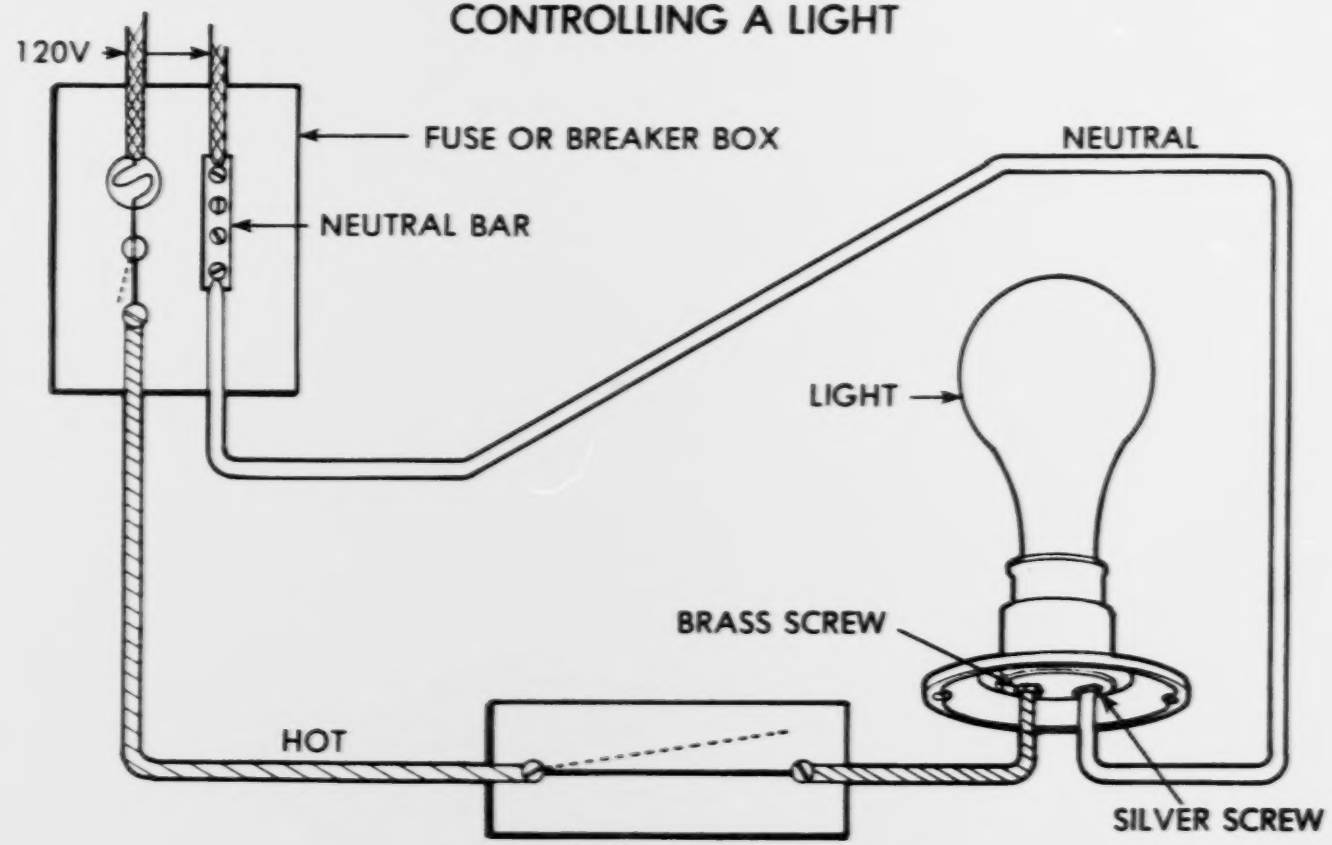
HAVE TWO POSITIONS-OPEN OR CLOSED

ARE NEVER INSTALLED IN A NEUTRAL LINE



SIMPLE SWITCH

CONTROLLING A LIGHT



SINGLE POLE-SINGLE THROW SWITCH

COMPETENCY

022. Compute Problems Involving the Amount and Cost of Electric Energy

COST OF OPERATING ELECTRIC EQUIPMENT

WATTS × HOURS OF OPERATION= WATT HOURS

$$\text{KILOWATT-HOURS (KWH)} = \frac{\text{WATTS} \times \text{HOURS}}{1000}$$

FOUR 200 WATT LAMPS= 800 WATTS

× 3 HOURS

2400 WATT HOURS

$$\frac{2400 \text{ WATT HOURS}}{1000} = 2.4 \text{ KWH}$$

ELECTRICITY @ 6¢/KWH

2.4 KWH × 6¢/KWH=14.4¢

OPERATION OF A 2 HP MOTOR (2000 WATTS) FOR 2 HOURS= 4000 WATT HOURS=

4.0 KWH × 6¢/KWH= 24¢

COMPETENCY

034. Identify the Factors Affecting Soil Formation

classification of PARENT materials

A. RESIDUAL MATERIALS

1. **Sedimentary** -limestone, sandstone, shale
2. **Igneous**- granite, basalt, andesite
3. **Metamorphic**- marble, quartzite, gneiss

B. TRANSPORTED MATERIALS

1. **Water**
   - A. Alluvial -flowing water
   - B. Lacustrine -lakes
   - C. Marine- ocean
2. **Wind**
   - A. Eolian - sand dunes
   - B. Loess- silt loam deposits (Miss. Valley)
3. **Ice**
   - A. Moraines
   - B. Till Plains
   - C. Outwash plains
4. **Gravity**- colluvial

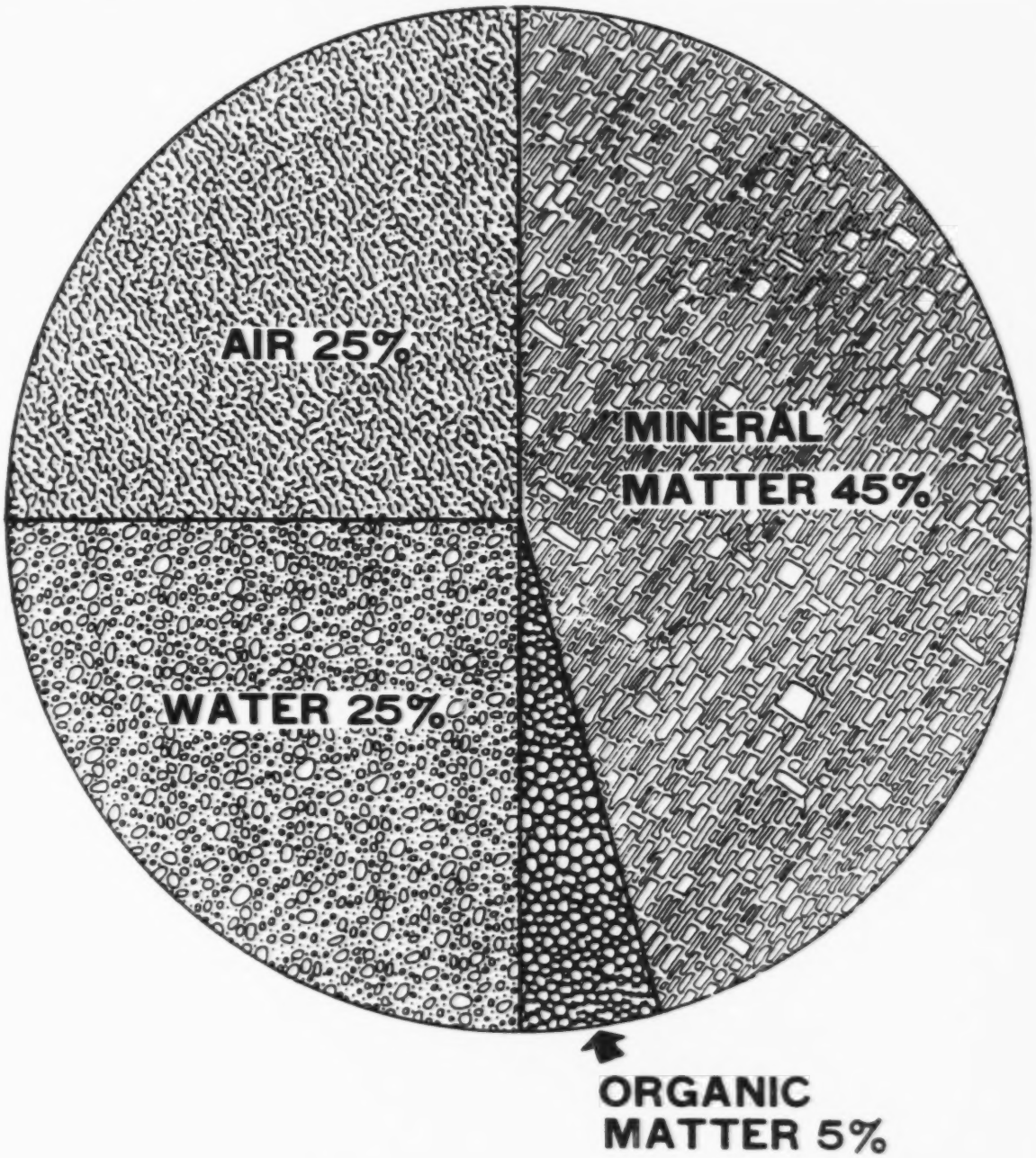
C. CUMULOSE MATERIALS

1. **Peat**- recognizable plant material deposits
2. **Muck**- plant decay deposits beyond recognition

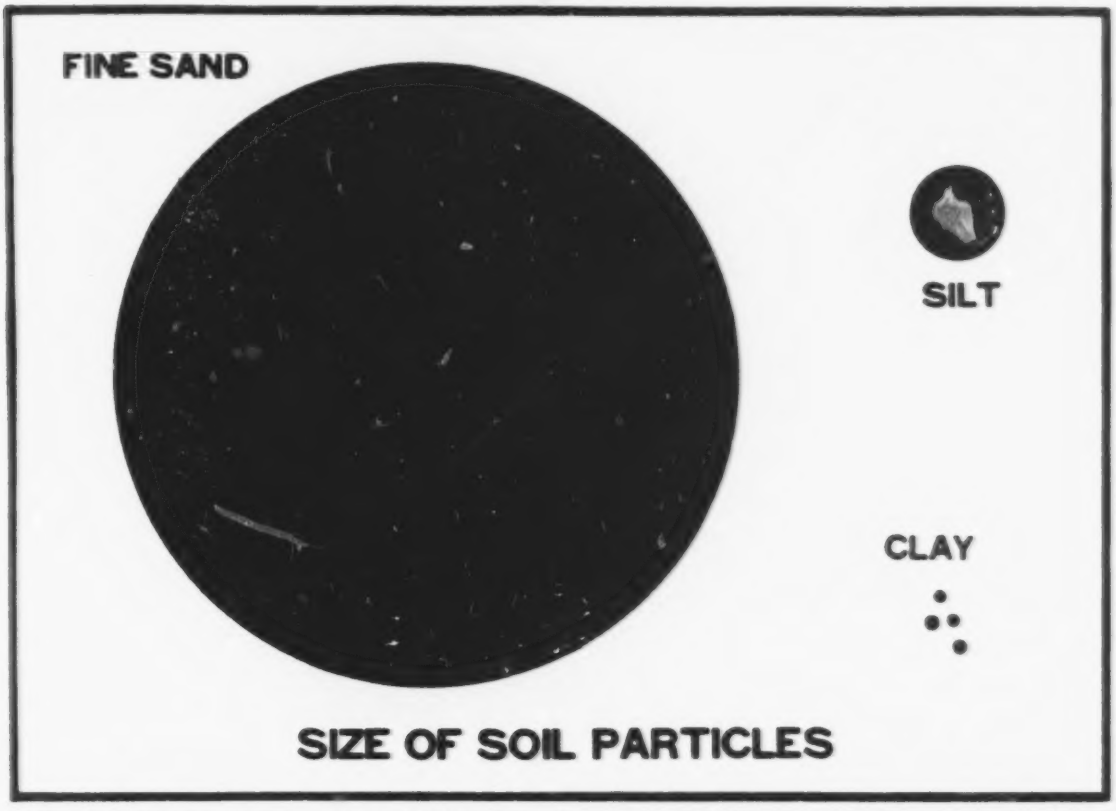
COMPETENCY

035. Describe the Various Properties of Soils

COMPOSITION of AVERAGE SOIL



THE RELATIVE SIZES OF SAND, SILT, AND CLAY PARTICLES



SIZE OF SOIL PARTICLES

NAME	SIZE, DIAMETER IN MILLIMETERS
FINE GRAVEL	2 - 1
COARSE SAND	1.00 - 0.50
MEDIUM SAND	0.50 - 0.25
FINE SAND	0.25 - 0.10
VERY FINE SAND	0.10 - 0.05
SILT	0.05 - 0.002
CLAY	LESS THAN 0.002

COMPETENCY

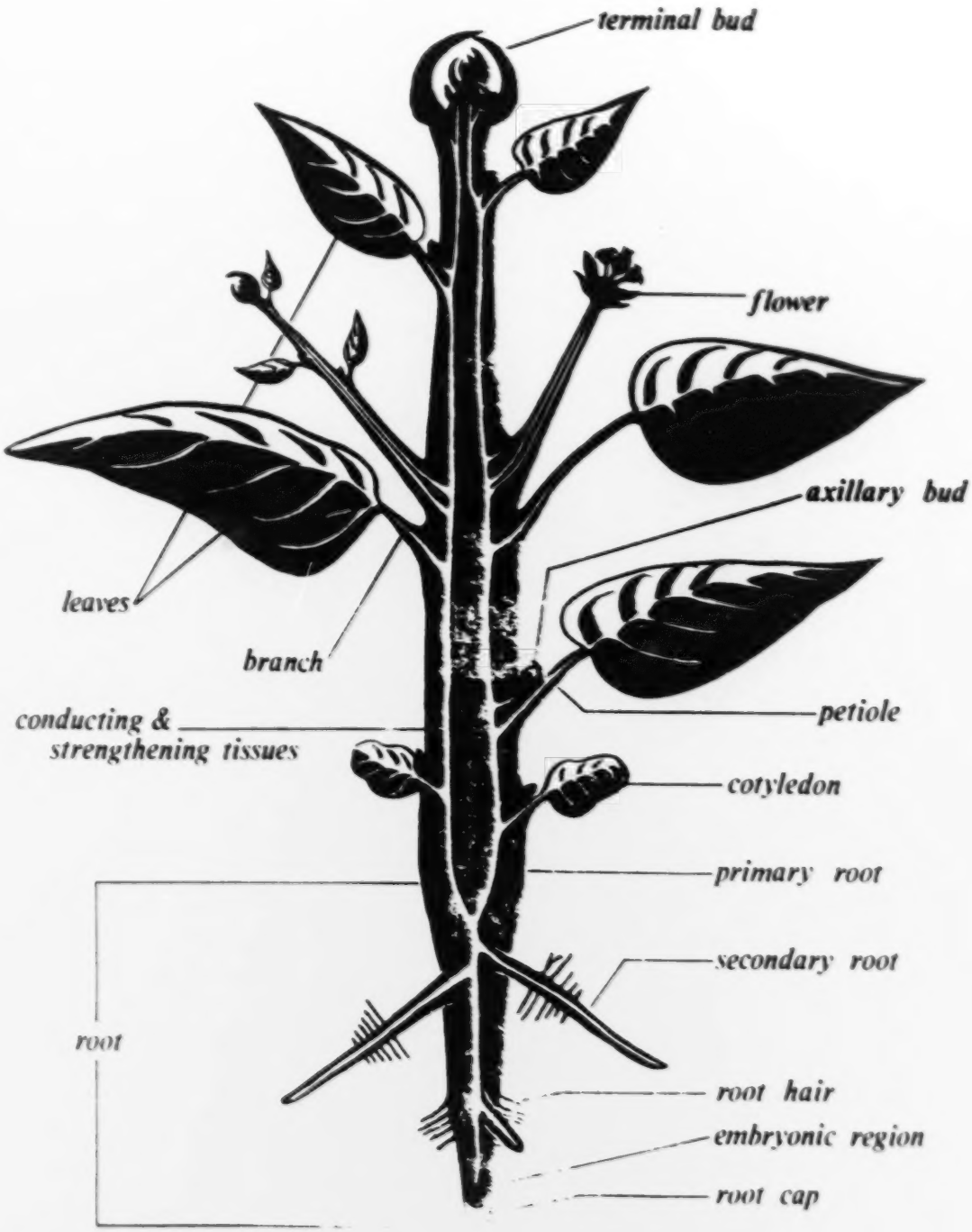
039. Identify and Classify Plants According to Use and Economic Value

SOME WORLD CONTRIBUTIONS TO THE CROP PRODUCTION OF THE UNITED STATES

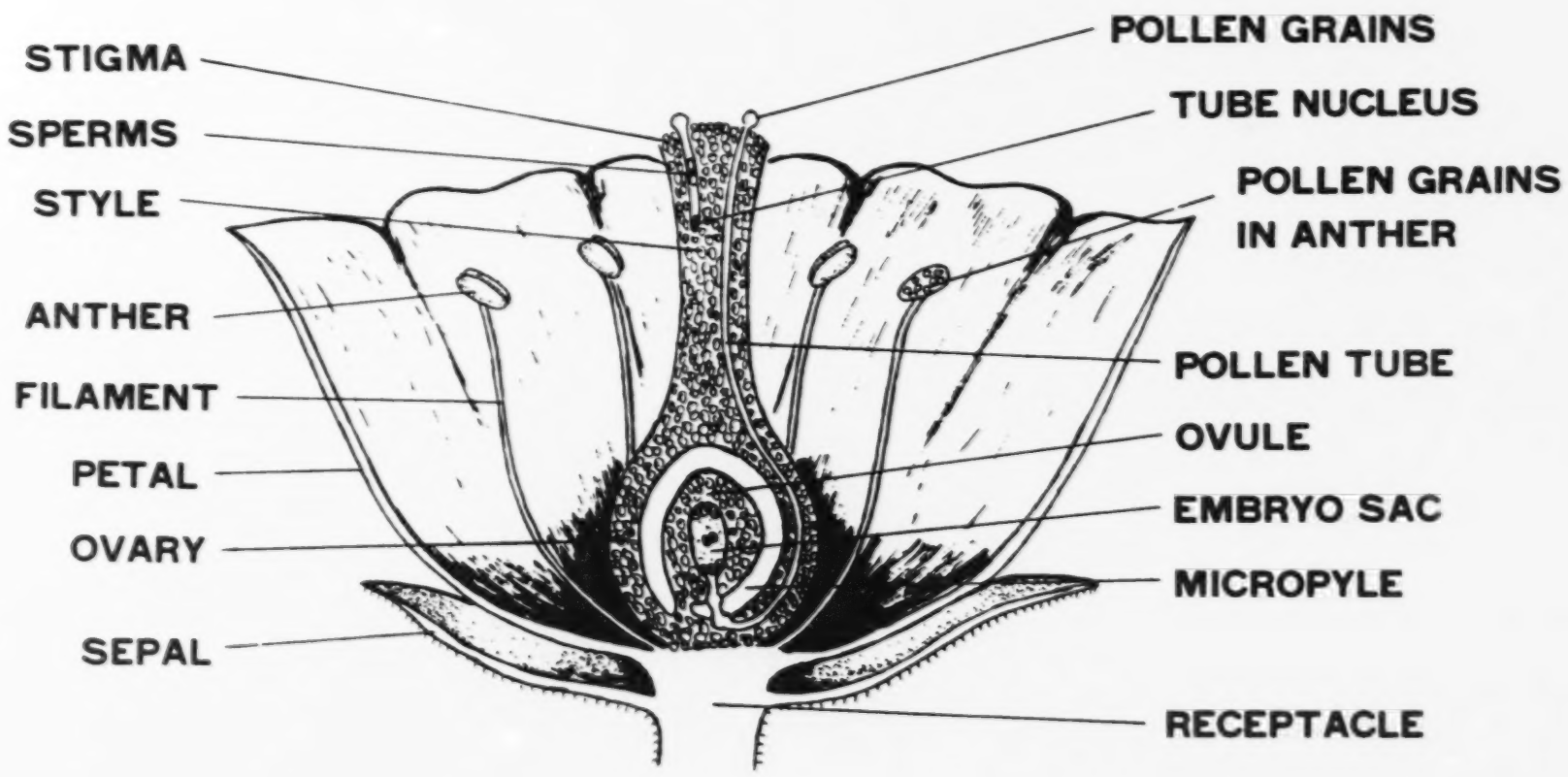
COMPETENCY

041. Identify and Describe the Functions of the Parts of Plants

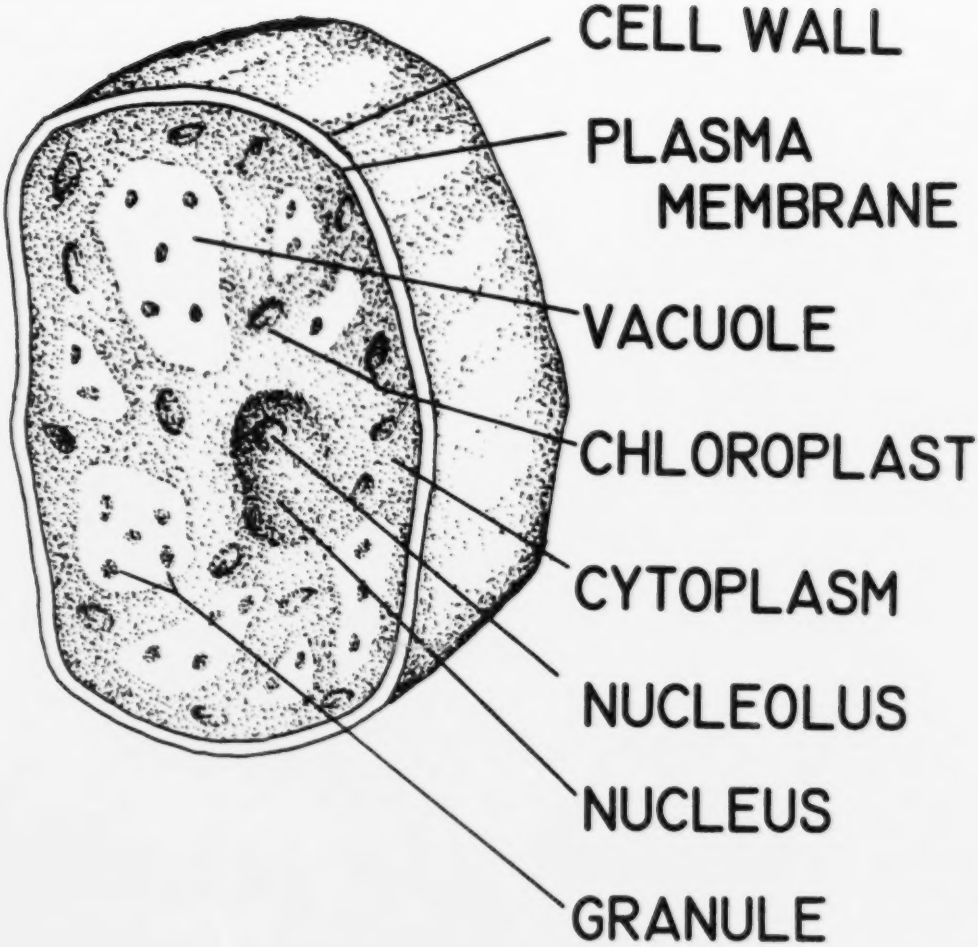
FLOWERING PLANT



PARTS OF TYPICAL FLOWER SHOWING POLLEN TUBE DEVELOPMENT



THE PLANT CELL

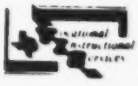


COMPETENCY

043. Describe the Advantages of Using Hybrid and Certified Seeds and Plants

LOSSES REALIZED
WHEN GOOD SEED IS NOT SELECTED

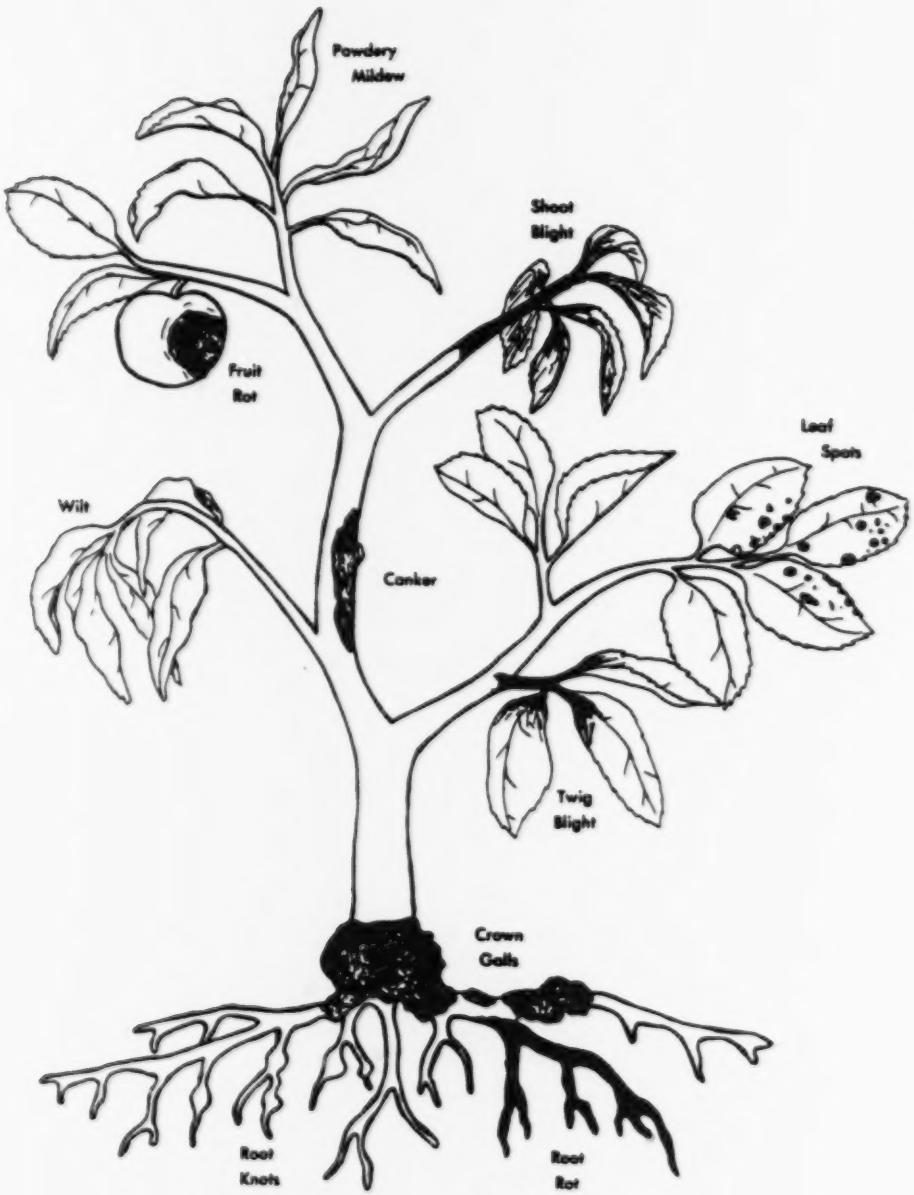
1. LOW GERMINATION PERCENTAGE
2. CONTAINS LARGE AMOUNT OF INERT MATTER
3. SUBJECT TO DISEASES
4. SUBJECT TO INSECTS
5. NOT ADAPTABLE TO CLIMATIC AND GROWING CONDITIONS
6. CONTAINS A LARGE AMOUNT OF OTHER CROP SEED
7. CONTAINS A LARGE AMOUNT OF WEED SEED



COMPETENCY

044. Identify at Least Five Diseases and Methods of Control of Plants Common to the Local Area

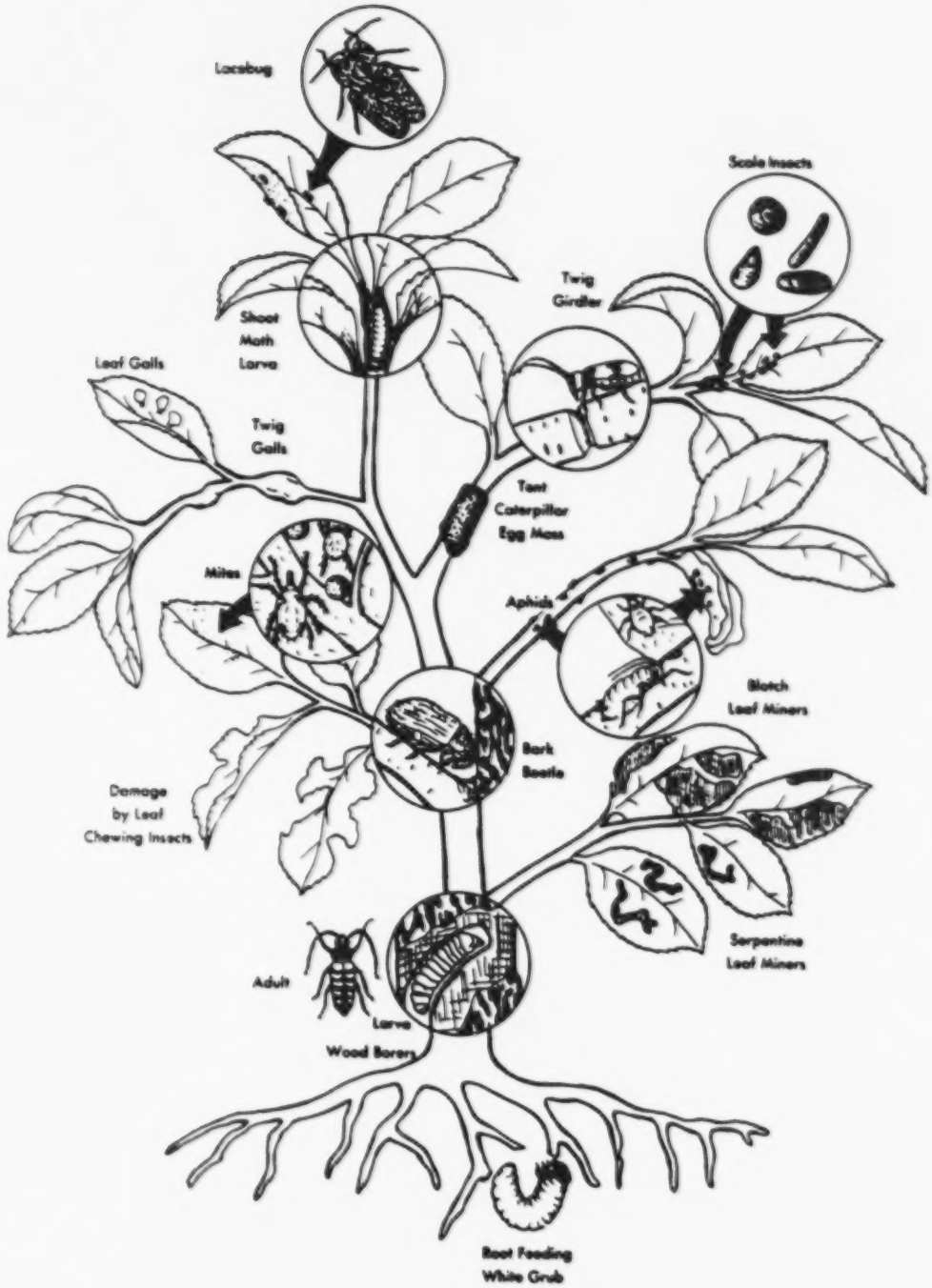
Symptoms of Diseases



COMPETENCY

045. Identify at Least Five Insects That Affect Plants in the Local Area and Methods of Control

Insect Damage



COMPETENCY

049. Describe at Least Three Reasons for Man to Conserve Natural Resources

WHO PAYS FOR CONSERVATION?

IF THE WORK IS NOT DONE—
Society pays through rising costs for:

1. WATER PURIFICATION
2. REHABILITATION OF RESERVOIRS
3. DREDGING OF RIVERS AND HARBORS
4. BUILDING COSTS OF HIGHER LEVEES
5. FUTURE CROP SHORTAGES
6. HIGHER FOOD COSTS
7. A DEGRADED ENVIRONMENT
8. DYING LAKES AND ESTUARIES
9. LOSS OF WILDLIFE
10. ANY NUMBER OF ESTHETIC VALUES

IF THE WORK IS DONE—
Paid for predominantly by the owners and operators of farm and ranch land.

The current annual conservation investment is about $ 1 billion and about one-third is paid by the federal government. Most of the other two-thirds is invested by the owners of the land.

TEACHING MATERIALS FOR

ORNAMENTAL HORTICULTURE I

COMPETENCY

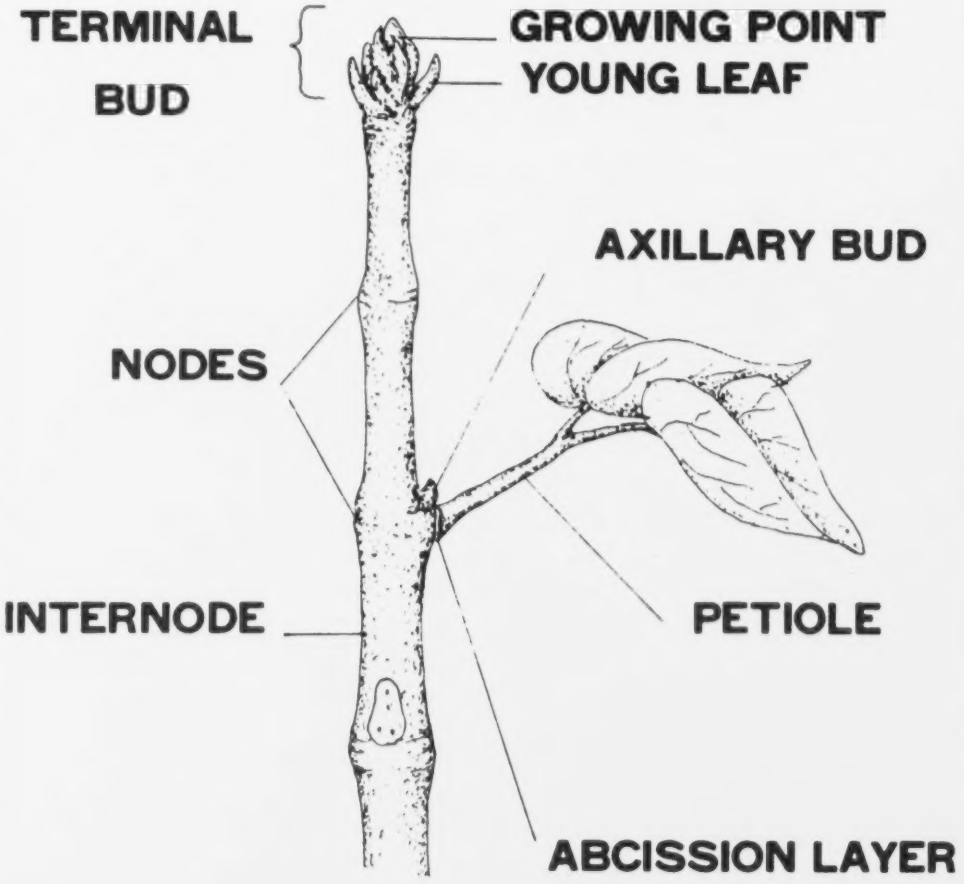
022. Identify the Principal Parts of Horticultural Plants
023. Identify and Explain the Functions of the Principal Parts of Horticultural Plants

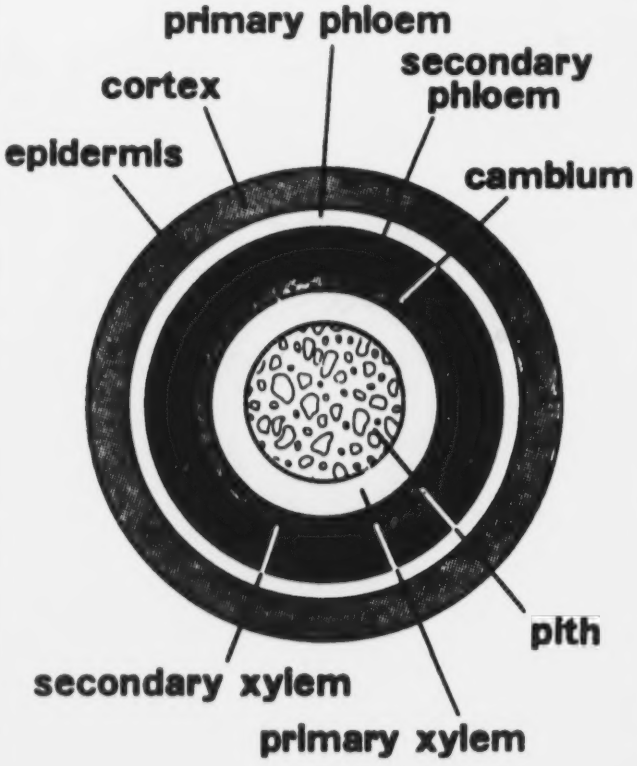
See Competency 041 Introduction to Agriculture/Natural Resources Course

COMPETENCY

024. Analyze the Processes of Growth in Horticultural Plants

STEM GROWTH





CROSS SECTION OF A STEM

PHOTOSYNTHESIS

THE CHEMICAL CHANGES THAT TAKE PLACE IN FORMING PLANT FOOD ARE:

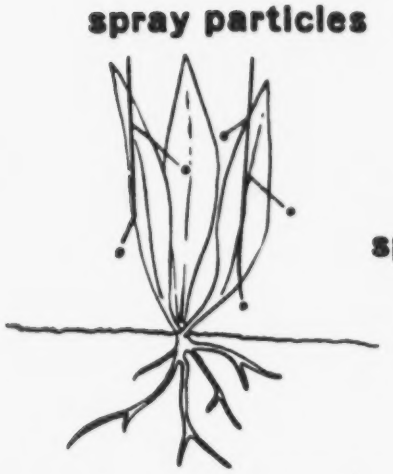
$$6\,CO_2 + 12\,H_2O + \xrightarrow[\text{CHLOROPHYLL}]{\text{LIGHT}} C_6H_{12}O_6 + 6\,H_2O + 6\,O_2$$

CARBON DIOXIDE + WATER + $\xrightarrow[\text{CHLOROPHYLL}]{\text{LIGHT}}$ SUGAR + WATER + OXYGEN

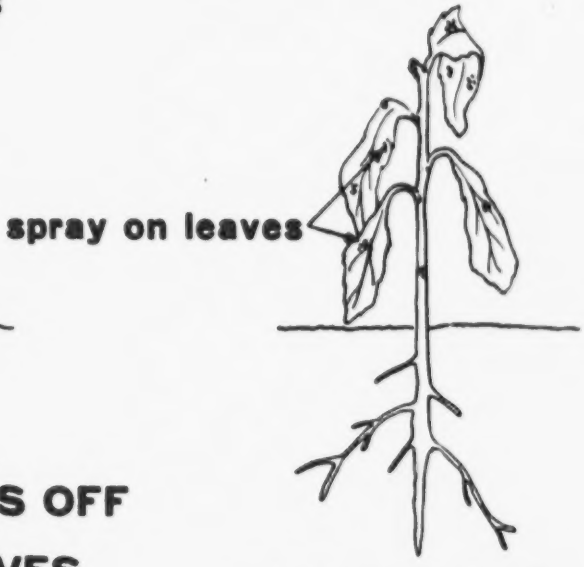
COMPETENCY

031. Identify and Demonstrate Proper Uses of Fertilizers and Chemicals

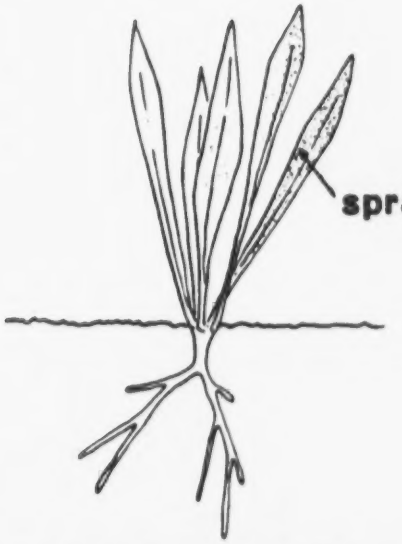
PLACEMENT OF HERBICIDES



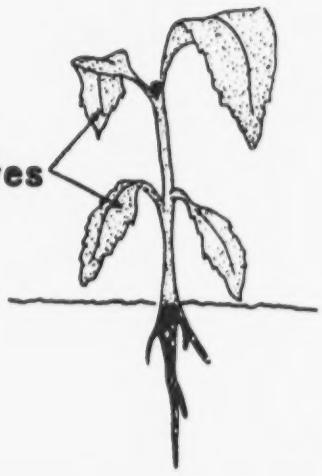
SPRAY BOUNCES OFF
UPRIGHT LEAVES



PLANT KILLED :
SPRAY STICKS TO LEAVES



PARTIAL COVERAGE
INEFFECTIVE



COMPLETE COVERAGE
KILLS PLANT

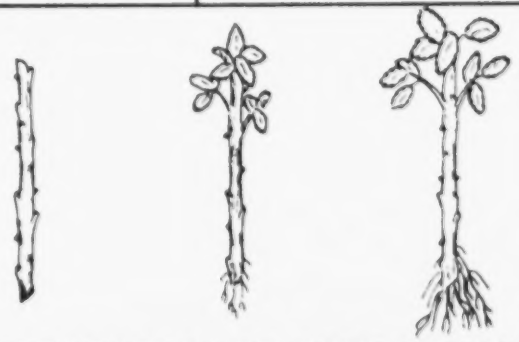
Courtesy of Vocational Instructional Services
Texas A & M University
College Station, Texas 77843

COMPETENCY

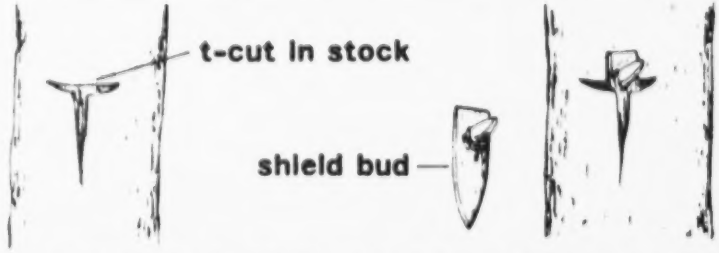
034. Identify and Describe Different Methods of Plant Propagation

PLANT PROPAGATION

MANY SPECIES OF BERRY PLANTS ARE PROPAGATED BY LAYERAGE

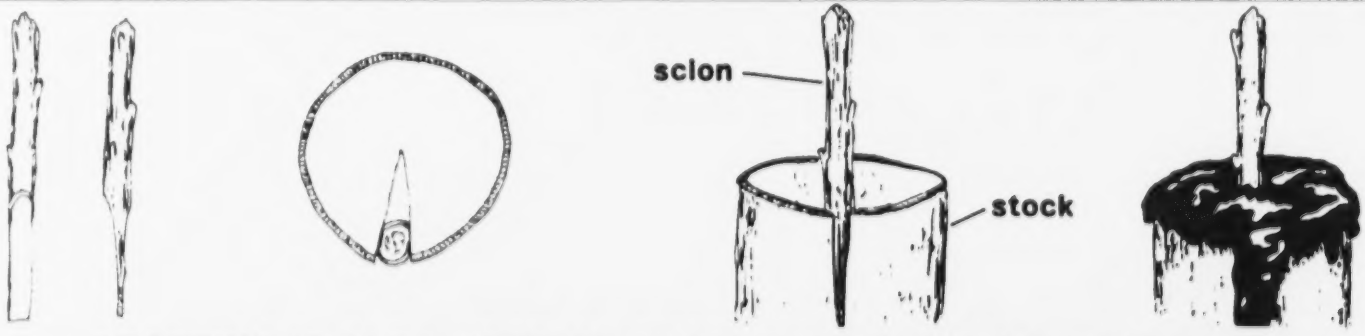


THE PROPAGATION OF ROSES IS MAINLY BY STEM CUTTINGS



BUDDING IS ONE OF THE MOST IMPORTANT METHODS OF ASEXUAL REPRODUCTION

BUDDING IS IMPORTANT IN FRUIT AND NUT PRODUCTION



GRAFTING IS ALSO USED TO PROPAGATE FRUIT AND NUT TREES

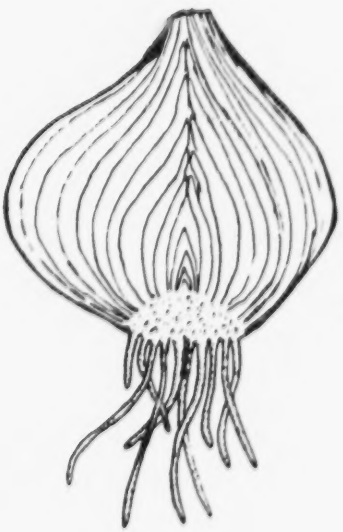
SWEET POTATO
PROPAGATED BY
STEM CUTTING

WHITE POTATO
PROPAGATED BY
MODIFIED
STEM CUTTINGS

BERMUDA GRASS
PROPAGATED BY
RHIZOMES

BERMUDA GRASS
PROPAGATED BY
STOLONS

ALFALFA
PROPAGATED
BY
STEM CUTTINGS



ONION
MAY BE
PROPAGATED
FROM THE
BULB

INTRODUCTION TO SECTION III OF THIS HANDBOOK

This section of the handbook contains a listing of selected resources available to you as vocational agriculture teachers which may be used to supplement your instruction of the previously identified science related agricultural competencies. The competencies identified in Section I of the handbook are listed followed by the name and description of at least one resource.

The resource is first identified as to type of material (filmstrip, student reference, transparency). Next, the title of the material is shown typed in all capitals. Following the title is a description of the material and information necessary for ordering the item. Prices were deliberately deleted because they often change from year to year and it is hoped that this handbook will be a valuable resource to you for many years. You may obtain information on price by writing for a catalog from the source listed and then ordering the item directly from the catalog.

Since all of these resources are science related, you are encouraged to confer with the science teachers at your school to see if they might benefit from using these materials also. Some resources are specifically oriented to vocational agriculture but many could be used in either an agriculture or science class.

RESOURCE MATERIALS FOR SCIENCE RELATED AGRICULTURE COMPETENCIES IN THE INTRODUCTION TO AGRICULTURE/NATURAL RESOURCES CURRICULUM

RESOURCE MATERIALS FOR SCIENCE RELATED

AGRICULTURE COMPETENCIES IN THE INTRODUCTION

TO AGRICULTURE/NATURAL RESOURCES CURRICULUM

Competency

013. Identify and describe proper use of tools and equipment.

Transparencies

SHOP TOOL IDENTIFICATION. Twenty-four transparencies include artists sketches of 171 common shop tools in six categories: carpentry and woodworking; engines and machinery; metalworking; various construction skills; hand power; and horticulture. Detailed transparencies on hammers, saws, brace and bit, and planes. A 12 page study guide provides additional information. Available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Drive, Urbana, Illinois 61801.

Videotape

USING HAND WOODWORKING POWER TOOLS, 1984. This videotape demonstrates the proper and safe usage of the following woodworking power tools: circular saw, saber saw, electric drill, various sanders, and the router. Various attachments are illustrated for each tool. Available from IAVIM Center, 208 Davidson Hall, Agricultural Engineering Department, Iowa State University, Ames, Iowa 50011.

019. Identify and describe processes involved in the generation and distribution of electricity.

Reference Guide

UNDERSTANDING AND USING ELECTRICITY. Content is primarily directed to the wise, efficient and safe application, installation, and use of electrical equipment and systems. By Bruce A. McKenzie and Gerald Z. Zachariah. Available from Interstate Printers and Publishers, Danville, Illinois 61832.

Student Manual

DISTRIBUTION OF ELECTRICITY ON HOME AND FARM (51 pages). A manual for planning for efficient and safe use of electricity. Available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Road, The Ohio State University, Columbus, Ohio 43210.

020. Define and describe the use of electrical terms.

Student Manual
Audio Visual

UNDERSTANDING ELECTRICITY AND ELECTRICAL TERMS. Shows how electricity works. Defines terms such as volts, amps, ohms, watts, and kilowatt-hours. Teaches students how to read meters and interpret electrical bills. Available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Road, The Ohio State University, Columbus, Ohio 43210.

021. Identify different kinds of electrical circuits and control devices.

Handbook

AGRICULTURAL WIRING HANDBOOK. Contains recommendations and suggestions for sizes of conductors, number and location of outlets, controls, and similar factors. Available from Instructional Materials Laboratory, 10 Industrial Education Building, University of Missouri-Columbia,Columbia, Missouri 65211.

Student Manual

CIRCUIT ANATOMY (76 pages). Manual describes and shows how to install electrical circuits. Available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Road, OSU, Columbus, Ohio 43210.

022. Compute problems involving the amount and cost of electric energy.

Slides or Filmstrip

DETERMINING AMOUNT USED AND COST OF ELECTRICAL ENERGY. Can be used to help teach students to work problems in electricity. Available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Road, The Ohio State University, Columbus, Ohio 43210.

027. Identify and describe the distinguishing breed characteristics of beef and dairy cattle, swine, sheep and poultry.

Slides

BREEDS OF BEEF CATTLE, 12 breeds, Order No. 5018
BREEDS OF DAIRY CATTLE, 5 breeds, Order No. 5019
BREEDS OF SWINE, 9 breeds, Order No. 5020
BREEDS OF POULTRY, 14 breeds of chickens and 5 breeds of turkeys, Order No. 5021
BREEDS OF SHEEP & GOATS, 14 breeds, Order No. 5022
STANDARD AND EXOTIC BREEDS OF BEEF BULLS, 31 breeds, Order No. 5023
Available from Vocational Instructional Services, FE Box 182, Texas A & M University, College Station, Texas 77843-2588.

Filmstrip

HISTORY AND BREEDS OF SHEEP, 1983. A 50 frame filmstrip and script on the history and breeds of sheep. The history is presented followed by pictures and characteristics of the 18 most common breeds in the United States. The last 18 frames present colored views of the 18 breeds for student review and identification. Available from IAVIM Center, 208 Davidson Hall, Agricultural Engineering Dept., Iowa State University, Ames, Iowa 50011.

028. Identify and describe the functions of nutrients essential for animal growth and development.

Student Manual

LIVESTOCK NUTRITION AND FEEDING. Includes digestive system, food nutrients, nutrient requirements, selection of feeds, and feed rations. Information features the why and how of livestock nutrition and feeding. Available from Instructional Materials Laboratory, 10 Industrial Education Building, University of

Missouri-Columbia, Columbia, Missouri 65211.

Student Reference Unit

LIVESTOCK FEEDING (39 pages). Basic uses of feed, classes, and types of feedstuff, feed efficiency, food nutrients and their sources, digestive systems of livestock, feed analysis, and balancing rations. Available from Department of Agricultural Education, College of Agriculture, University of Arizona, Tuscon, Arizona 85721.

031. Identify the most common pests and diseases of animals and methods of control.

Reference Book

ANIMAL HEALTH. Provides basic information on animal health and disease prevention. Discusses losses from lowered production, reduced growth rate, unnecessary cost of feed additives and medicine, and death of animals. Details carefully designed disease preventive programs. By J. K. Baker and W. J. Green. Available from Interstate Printers and Publishers, Danville, Illinois 61832.

034. Identify the factors affecting soil formation.

Sound Filmstrip

SOIL AND THE AGRICULTURAL ENVIRONMENT. Examination of soil's part in survival. Students see and hear the fascinating story of how soil is formed over millions of years...and how it can be destroyed in a few days or hours through carelessness. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

Color Slides

INVESTIGATIONS IN SCIENCE: EARTH SCIENCE. Examines the nature of the materials that make up the earth's crust. The processes which affect these materials are made understandable through a variety of experiments. Available from John L. Glisson, Inc. Audio Visual Distribution, 819 West Broad St., Richmond, Virginia 23220 (Write for catalog).

035. Describe the various properties of soils.

Student Reference

SOIL SCIENCE STUDENT MATERIALS, 1983. Self-contained topics for advanced student use. Contain technical information, illustrations, and selected student activities. No additional references required. Available from Vocational Instructional Services, Texas A & M University, FE Box 182, College Station, Texas 77843.

039. Identify and classify plants according to use and economic value.

Color Slides

FOLIAGE PLANTS, 1983. A series of 172 slides and illustrated script describing the major identifying features of 154 commercially important foliage plants. Each slide depicts a close-up of the subject to aid students in noting general characteristics. Plants are grouped by family to facilitate the recognition of common characteristics and cultural techniques. Both scientific and common names of each plant are given along with a phonetic pronunciation for each scientific name. A glossary of pertinent terms and indexes for both scientific and common names are also provided. Available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Road, Columbus, Ohio 43210.

040. Identify primary and secondary nutrient requirements of plants.

Color Slides

ESSENTIAL PLANT NUTRIENTS. Shows critical nutrient deficiencies that plague agricultural crops and how they can be prevented. Primary and secondary nutrients and the nitrogen cycle are illustrated to show students how nitrogen and other nutrients are absorbed from the soil. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

041. Identify and describe the functions of parts of plants.

Reference Manual

PLANT GROWTH AND DEVELOPMENT. A basic manual on plant growth and development. The processes described are germination, seedling growth, absorption, photosynthesis, respiration, transpiration, and reproduction. Available from Ohio Agricultural Education Curriculum Materials Service, Room 254, 2120 Fyffe Road, The Ohio State University, Columbus, Ohio 43210.

042. Identify and describe methods of plant reproduction.

Student Reference Unit

PLANT GROWTH AND DEVELOPMENT (81 pages). Shows plant parts, reproduction, classification, selection of quality seed, photosynthesis, transpiration, respiration and plant nutrients. Available from Department of Agricultural Education, College of Agriculture, University of Arizona, Tuscon, Arizona 85721.

043. Describe the advantages of using hybrid and certified seeds and plants.

Slides

FLOWERING PLANTS AND SEED PLANTS - A SURVEY, A SLIDE RESOURCE. Examines the life history of a typical flower, and illustrates the life cycle of the lily. The set then presents an overview of seed plants with examples of characteristics methods of growth and reproduction. Available from The Center for Humanities, Inc., Communications Park, Box 1000, Mt. Kisco, New York 10549 (Write for catalog).

Slide Tape

COMPREHENSIVE BREEDING SYSTEM. This slide tape presentation is an introduction to the corn breeding program unique to Funk Seeds International. It shows the rigorous system of breeding and testing hybrids for a broader genetic base, higher yields, and more consistent performance. Available for free loan from Venard Films, Ltd., Box 1332, Peoria, Illinois 61654.

044. Identify at least five diseases and methods of control of plants common to the local area.

Bulletin

IDENTIFYING DISEASES OF VEGETABLES. A Penn State publication. Available from the N. C. Agricultural Extension Service.

Bulletin

PLANT DISEASE DEVELOPMENT CALENDAR. (AG 135). Available from the N. C. Agricultural Extension Service.

Bulletin

NORTH CAROLINA PLANT DISEASE INDEX (TB 240). Available from the N. C. Agricultural Extension Service.

045. Identify at least five insects that affect plants in the local area and methods of control.

Bulletin

INSECTS AND RELATED PESTS OF FLOWERS AND FOLIAGE PLANTS (AG 138)
INSECTS AND RELATED PESTS OF FIELD CROPS (AG 271)
INSECTS AND RELATED PESTS OF VEGETABLES (AG 295)
Available from the N. C. Agricultural Extension Service.

Bulletin

THINGS YOU SHOULD KNOW ABOUT SELECTING GARDEN INSECTICIDES (AG 252). Available from the North Carolina Agricultural Extension Service.

047. Demonstrate ability to propagate plants using three specified methods.

Student Reference

PRODUCING PLANTS BY ASEXUAL PROPAGATION, 1983. Topics discussed include how to propagate new plants, what material to use as a rooting medium, placement of cuttings in the rooting medium, and a new section of special propagation methods. The appendix describes and illustrates several student exercises. Available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Drive, Urbana, Illinois 61801.

Slide Set

INTRODUCTION TO PLANT PROPAGATION BY TISSUE CULTURE, 1983. Introduces tissue culture, a relatively new plant propagation method. Supplies, equipment, and techniques used in tissue culture are described. Conditions required to maintain established cultures are also discussed. Available from Vocational Agriculture Service, University of Illinois, 1401 S. Maryland Drive, Urbana, Illinois 61801.

049. Describe at least three reasons for man to conserve natural resources.

Reference Book

INVESTIGATIONS IN CONSERVATION OF NATURAL RESOURCES. A practical conservation education workbook. The manual contains 26 investigations into most of the major conservation topics and environmental issues facing us today. By R. A. Lytle and Harry B. Kircher. Available from Interstate Printers and Publishers, Danville, Illinois 61832.

050. Identify the major fish species in specified waterways.

Book

FISHES - A GUIDE TO FAMILIAR AMERICAN SPECIES. Pictures of common American fish with a description of their characteristics. By Zim and Shoemaker. Available from Golden Press, New York, New York.

051. Identify the sources and physical qualities of water.

Bulletin

AGRICULTURE AND WATER QUALITY (AG 281). Available from the North Carolina Agricultural Extension Service.

Slides

WATER: CHEMICAL, PHYSICAL, AND BIOLOGICAL ASPECTS. Examines and describes the special physical and chemical properties of water that have been a major force in life as we know it. Program describes the water cycle and the role water plays in shaping the landscape. Problems resulting from poor management of water resources are explained and new approaches to the restoration

and preservation of the water supply are discussed. Available from the Center for Humanities, Inc., Communications Park, Box 1000 Mount Kisco, New York 10549 (Write for catalog).

054. Identify the main categories and sources of pollution.

Slides

AGRICULTURE AND THE ENVIRONMENT, 20 minute slide presentation takes a concerned look at environmental pollution. A factual script discusses the role agriculture plays in today's pollution problems. Sponsor: CIBA-GEIGY CORPORATION. Available for free loan from Venard Films, Ltd. Box 1332, Peoria, Illinois 61654.

055. Identify at least three ways modern agricultural practices have improved the environment.

Slides

BENEFITS OF FERTILIZERS TO THE ENVIRONMENT. Shows the importance of environmental maintenance and how the judicious use of fertilizers can lead to an improvement in man's environment and how excessive use can cause environmental problems. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

RESOURCE MATERIALS FOR SCIENCE RELATED AGRICULTURE COMPETENCIES IN THE ORNAMENTAL HORTICULTURE I CURRICULUM

RESOURCE MATERIALS FOR SCIENCE RELATED

AGRICULTURE COMPETENCIES IN THE ORNAMENTAL

HORTICULTURE I CURRICULUM

Competency

022. Identify the principal parts of horticultural plants.
023. Identify and explain the functions of the principal parts of horticultural plants.

8 page handout

PLANT STRUCTURE - FUNCTION OF PLANT PARTS. No. 8060. Student materials showing parts of plants with explanation of function (8 pages). Available from Vocational Instructional Services, F. E. Box 182, Texas A & M University, College Station, Texas 77843-2508.

024. Analyze the processes of growth in horticultural plants.

Sound Filmstrip

KINGDOM OF THE PLANTS, 1974, Variety of plants and the roles they perform in our environment. Processes of reproduction and photosynthesis explored. Five sound filmstrips, running time 13-14 minutes each. Titles - Green Life, Simple Plants, Complex Plants, Trees, Plants Serving Man. Available from National Geographic Educational Service, Washington, D. C. 20036 (Write for catalog).

031. Identify and demonstrate proper uses of fertlizers and chemicals.

Slide Set

FERTILIZER FORMULATION STORAGE AND HANDLING, Shows how fertilizers are formulated into homogenous products, bulk blends, liquids, and suspensions. Students learn how to handle and store fertilizers for maximum safety and efficiency. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

Sound Filmstrip

FERTLIZING ORNAMENTAL PLANTS, Shows importance and effects of aeration, moisture content, pH, soil structure and the influence of parent material on nutrient availability. Common symptons of nutrient deficiencies along with the best fertilizers to offset or prevent the conditions are portrayed. Introduces students to major fertilizers and their application methods. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

Slide Set

METHODS OF APPLYING FERTILIZER, Methods of application and adjusting equipment for accurate applications and ways of overcoming problems related to fertilizer applications. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

Sound Filmstrip

CONTROLLING PESTS OF ORNAMENTAL PLANTS, Shows how to protect ornamental plants from weeds, diseases, and noxious insects. Safe use of chemicals and utilization of biological or mechanical controls. Discusses proper clothing, equipment and clean up procedures. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

Film

PESTICIDES: FUNDAMENTALS OF PROPER APPLICATION. The film discusses how to get the most out of your chemical dollars. It starts with an explanation of basic spray equipment and moves into how to regulate spray equipment for the best application. Available from Venard Films, Ltd., Box 1332, Peoria, Illinois 61654.

034. Identify and describe different methods of plant propagation.

Sound Filmstrip

PROPAGATING ORNAMENTAL PLANTS. Shows modern propagation skills showing how to properly graft, bud, layer and divide ornamental plants. Shows how plants are propagated, from selection of the mother stock or scion to the finished rooted material. Section on germination and transplanting temperatures, growing media and soil sterilization. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).

037. Identify selected bedding plants according to growth, habit and use.

Sound Filmstrip

BEDDING PLANT PRODUCTION, Shows every step of bedding plant production from germination to labeling. Detailed photographs show how to prepare growing media, sow seeds, regulate growth through temperatures and chemicals, control pests, and transplant seedlings to containers for sale. Available from Vocational Education Productions, California Polytechnic State University, San Luis Obispo, California 93407 (Write for catalog).